Livestock Waste Management in East Asia
LWMEA (GCP/RAS/215/WBG)

The World Bank | Global Environment Facility | The Food and Agriculture Organization

Technical Backstopping on Manure Management & Environmental Monitoring

Tan-An, South Vietnam

July 26 – 28, 2007

Hong Lim Choi

Department of Agriculture, Guangdong Province of China | Department of Livestock Development, Thailand | Ministry of Natural Resource and Environment, Viet Nam

Table of Contents

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A. General Observations for the Project

Under the terms of reference, Hong L. Choi, an international consultant for the FAO, took a mission trip to Hanoi, and HoChiMin City, Vietnam from July 26 through 28, 2007. This particular mission in VietNam this time was designed to evaluate and advise to FAO and WB whether the recently chosen pig farms in Tan An Commune, Vinh Cuu District in Dong Nai Province, South VietNam were qualified for the LWMEA Project.

Several households in Trang Dai Ward village was originally proposed for LWMEA Project region. The region was composed of seven independent medium-size pig farm. However, due to rapid urbanization of Trang Dai Ward and its neighboring area, the Dong Nai Provincial Government and PMU decided to shift the project area to Tan An Commune in Vinh Cuu District. This district is situated in the north-east of Dong Nai Province, and about 60km apart from HCM city. As shown in **Figure 1.1**, the project area is very close to the Dong Nai river which is directly linked to the South China Sea. The water quality of Dong Nai is significant not only because it is the main source of tap water for six million people in HCM City but also because it is the most important criteria for the selection of demonstration farms regarding the LWMEA project .

Tan-An, South VietNam

Schedule: The consultant carried out his mission as scheduled. The first morning, he visited CTC (Consultancy and Technology Transfer Center_President X. N. Nguyen) with Dr. Chinh, to figure out the progress of Monitoring and Evaluation (M&E) for the treatment system, the demo. farm and its neighboring watershed. The CTC was designated to be responsible for performing the M&E of the project. Both sides discussed the general aspects of M&E for surface water, groundwater, and odor. In addition, the parameters to be collected, sample sites, frequency of the sampling, and points to be checked for sampling were also discussed..

In the afternoon, the consultant held a meeting with the PMU members, Tai and Duc, and Dr. Chinh in order to determine their progress regarding technical system design and M&E for Tu Dong village, Ha Tay province, North Vietnam, and Tan An commnue, Dong Nai province, South Vietnam. In addition, they also exchanged thoughts on launching a new project on 'Education and Training Program for Livestock Wastewater Treatment' between S. Korea-ASEAN.

In the evening, Dr. Chinh and the consultant flew to HCM city and took a field survey to six farms in Tan An Commnue to examine whether the farms were eligible for the LWMEA Project. The consultant used the selection criteria proposed in the **Annex 3 in**

Preparation Mission Aide-Menoire, March 14-26, 2004, modified by the consultant in making their determination.

The next day on 27 July, 2007, the consultant visited six candidate farms in Tan An Commnue. All the basic statistics of crop and livestock farming is shown in **Table 1.1**.

Basically the consultant came to realization that all sorts of water in Tan An commune flows in Rach Dong tributary river that merges with main stream of Dong Nai river.

Table 1.1 Statistics of crop and livestock farming in Tan An Commnue

Field	Item	Unit	Total quantity
Population	Resident	p (person)	**8,230**
Land	Natural area	ha	**5,270 (1.56 p/ha)**
Household	Household	hh	**1925 (2.74 p/hh)**
Crop	Agricultural land	ha	**2,463.0**
	Vegetable land	ha	**15.0**
	Orchard land	ha	**371.0**
Livestock	Pig farm	farm	**450**
	No. of pig	head	**18,000 (40 hd/farm)**
	No. of cattle	head	**2,100**
	No of poultry	bird	**122,000**
Fish	**Fish pond**	**ha**	**213**

B. Assesement of the six-Candidate Pig Farm in Tan an Commune

1. The Criteria for the Selection of Project Farms

The proposed criteria for the selection of demonstration farm should embraces (a) achieving measurable pollution reduction within the duration of the project and (b) demonstrating good manure management practices for their replication in other areas. For these reasons, the farms (or areas) that will be implemented should:

- Be allowed to measure the reduction of pollution in surface water systems due to better livestock waste management at the end of the project.
- be representative of current and future environmental problems related to animal waste, so that there is a high likelihood that the results associated policies and technology options are transferable to other areas;

1) List of Proposed Criteria

The following is a list of proposed criteria to be used in identification and/or selection of suitable project sites (study areas) for the planned project.

(1) Mandatory List

- Pig production needs to be the dominant cause of water pollution in the area. Ideally, it should account for over 50% of released nutrients (especially in terms of source of N, P and organic matter) *ie*: as much or more than all other livestock activity, domestic and industrialized pollution sources combined.
- The trend in the region should be one of increasing or steady pig livestock activity; a region with declining pig farming would not be suitable.
- The selected area should be a connecting basin representing a *single geographical catchment area:* the boundaries should be easily identifiable. As such, there should be no inflow of water into the study area from neighboring regions. In addition, the drainage of the area should run to a single surface stream to enable impact measurement.
- Local willingness both at policy level (local authorities are interested in the issue and demonstrate ownership) and farmers level (at least 70-80% of the farms should cooperate), potential counterpart fund, and capacity in environmental management.
- The size of the study area should be enough to encompass between 50.000 and 150.000 pigs (SPP or standing pig population).

(2) Optional List

- An area in which the level of underground water drainage is minimal, ie., most of the collected rainwater + field drainage leave the study area by surface water.
- The area would ideally include various types of pig production: for example, large modern production units, small family farms, community schemes etc.
- The two study areas are preferably located in different agro-ecological zones to demonstrate potential differences of soil, climatic regime and environmental conditions.
- The two selected areas should ideally have different main crops.
- A region where previous studies had be completed on water, soil or public health would be particularly useful to include (the resulting data being of benefit to the current project).
- A region that is reasonably accessible – no more than 3 hours journey from Universities/Local Government offices providing technical support.
- The following is a list of proposed criteria to be used in identification and/or selection of suitable project sites (study areas) for the planned project

2) Localized Criteria for Selection of Project Farms

Because the rephrased criteria of **Annex 3 in Preparation Mission Aide-Menoire, March 14-26, 2004**.aforementioned in Section 1) List of Proposed Criteria were not available for VietNam, the selection criteria embodied by Chinese PMO was invoked to assess the candidate farms in Tan An Commnue Dong Nai province, South Vietnam, as follows : .

- The farm shall comply with provincial government regulation. In particular, all the pig farms should be relocated to anther area other than Trang dai ward.
- Pig production should be one of the dominant causes of water pollution in the area;
- There should be an increasing or steady trend of livestock activity;
- Willingness to participate from local authorities and farmers, with a potential counterpart fund and environmental management capacity;
- The selected farms are representative of the various pig production technologies in Dong nai Province;
- Large farms according to national standards (at least 200 sows or 3000 finishers);
- The selected farms for demonstration should possibly be clustered;
- The farm is well managed and can prove satisfactory financial situation;
- The farm currently pollutes a stream (river or canal) that is a primary or secondary tributary of the Dong Nai River.

2. Technical Design and M&E for Candidate Farms in North and South Vietnam

(1) Technical Design

The heart of the project lies with the introduction and operation of appropriate manure management technologies on a sufficient scale in selected areas to demonstrate the feasibility of sustainable pollution abatement. Individually, various manure management technologies have already been proven under earlier projects in the region to be of benefit in reduced water pollution; in the proposed project.

The current system scheme for livestock manure treatment in North Vietnam is an integration of pig farm-biogas digester-fish/aquatic plant pond and/or fruit orchard on household scale. Thus the communal system seems to be effective to treat pig wastewater especially in the North where the scale ranges from 20-30 head per

household and is densely concentrated in the Tu Duong village on the Red River Delta in which water flows into the Nhue river and eventually introduced into the Red river that is largest in the North.

The technology designs for the three groups of six pig farms in Tu Duong village, To Hieu commune, and Hay Tay province in North Vietnam have completed. The first one is a communal pig wastewater treatment system for households in the village. Its proposed system comprises six biodigesters of 380m^3 in volume and is accompanied by two open lagoons with the volume of 680m^3 for stabilization. The treated water can be reused for irrigation water for paddy field or for fish farming. The 2nd one is a group system which comprises an anerobic covered lagoon accompanied by a stabilized open lagoon. The last one is an independent system having a cylindrical biodigester of which residues run into a communal system through the livestock wastewater transportation canal that was newly built. The PMU sets the schedule for construction of the treatment system, starting from October 15, and it will continue for two months. The details of the technical design are currently not available but it will be thoroughly reviewed in the November mission.

(2) Monitoring and Evaluation

The deployment of technologies will demonstrate the impact of implementation in the project area where livestock farming especially from pig production is dominant. The areas are chosen where the net benefit of the particular technologies applied on the quality of water and other variables can most successfully be demonstrated. If the construction of livestock wastewater treatment is completed at the beginning of 2008, the impact of the system can be demonstrated by Monitoring and Evalution of the system and the demonstration farm and its vicinity. The M&E study will begin immediately after construction in North Vietnam.

Because the main mission assigned to the consultant was to examine the eligibility of the groups of six pig farms in Tan An Commnue, he was to focus on the mission for LWMEA Project operated by the FAO.

C. Assesement of the three groups of farms in Tan An commune, South VietNam

The six farms are located in Tan An Commnue, Vinh Cuu District, Dong Nai Province, South VietNam, bordered with Dong Nai River. The farms were grouped into three units for livestock wastewater treatment system according to the size of the farm and closeness in distance. The consultant exchanged his thoughts about a proper group system for each unit in consideration of its locality of the groups in Tan an commune with Dr. Chin Bui. Both agreed not to put off the issues of **Monitorng and Evalution (M&E)** and **Technical Design (TD)** in the November mission, in order to concentrate on the main assignment given to the consultant.

The assessment was carried out to judge the suitability of inclusion in LWMEA Project. The same evaluation sheet was used for the selection of six farms in Tan an commune, of which clauses were modified to reflect the locality of Tan An commune in S. VietNam. The assessment clauses include most importantly, the impact of pig wastewater from farm to waterstreams and clusterness in a limited region. The next priorities may go sequentially to local government, and pig farmers' willingness, cost sharing, suitability of a standard technical design, and the farm size and trend in the future.

The evaluation scale is classified into five grades of each clause in **Table 2-1.** For instance, a 'very good' receives the highest grade **'5**', 'good' receives a '**4**', moderate receives a '**3**', poor receives a '**2**', and 'very poor' receives a '**1**'.

The selection criteria in **Table 2-1**, are categorized into five groups, including '**L**' stands for 'Location of the farm', '**WQ**' for water quality, '**M**' for management, '**W**' for 'willingness of local government and producers', '**T**' for technology suitability.

1. 1st Group Pig Farms

1) Characteristics of 1st Group Farm and Present Treatment System

The 1st group includes three individual household farms, two small and one medium scale, as shown in **Table 2.1**. The total number of finisher and sow are 800 and 106 respectively. The total amount of pig wastewater may produce approximately 3 m^3/day that includes flushing water. Basically, the 1st two farm households did not have a

treatment system. The wastewater mixed with rainfall water and sewage is discharged into a ditch which eventually flows into public waterway. Unlikely Lai and Dien farm, Thien farm household operates a Vietnamese conventional biodigester which holds a volume of 25m^3, and is made out of mud yellow soil bricks. The residue wastewater from the biodigester has been treated further, and discharges into a ditch as other farms would.

Table 2.1 Characteristics of 1st group of pig farm in Tan An Commune, S. VietNam

No	Township	Name of farm	no. of finisher, head	No. of sow head	Fish pond area, ha	Crop/Fruit land area, ha
1	Tan An	N.T.X. Lai	150	N/A	0.03	**0.8**
2	〃	T.X.Dien	50	6	N/A	**0.2**
3	〃	L. T. Thien	600	100	0.07	**0.5**
Total			**800**	**106**	**0.10**	**1.5**

2) Proposed Treatment System

The pig wastewater treatment system for the 1st group including the three farms in **Table 2.1** was proposed by the PMU, VietNam and is as follows: ① the solid is separately collected at the pig house and is dried under a roof, preventing the composting materials from rainfall and can be consumed for their own use in cropland or sold as a compost. ② construct a channel for pig wastewater to separate the discharge from the rainfall which will not only greatly dilute but will become a serious non-point pollution source. ③ construct an anaerobic covered lagoon and ④ their residue wastewater after digestion may be stored in an open lagoon which can be reused for crops and fish for feedstuff.

The gas generated can be used for heating, cooking and even electrification. Their schematic block diagram is shown in **Figure 2.1** for 1st group pig wastewater treatment system proposed by the PMU, VietNam.

3) Modification of Clauses for VietNam

However, each clause of the criteria list in **Table 2.2** may not be clearly placed into the five categories, because some of the clause may overlap their functions. In case, the clause is placed in the category which seems to be the most significant

- **Farm Size** : The assessment sheet shown in **Table 2.2** was used again as it was used for the selection criteria for candidates in China, except that the clause ⑥ relates to farm size. This clause was originally designed to include in the selection criteria to indicate that a bigger farm may have a higher risk in appropriately treating pig slurry and that it should receive a higher priority for selection. However, although the size of each farm in Vietnam may not be comparable to China, or Thailand, pig wastewater is produced from tens and hundreds of small households in the community, and is mixed with other polluted water sources. This pattern of pig wastewater system seemed to be more serious than any other model and should be given 'the most alert' circumstance.

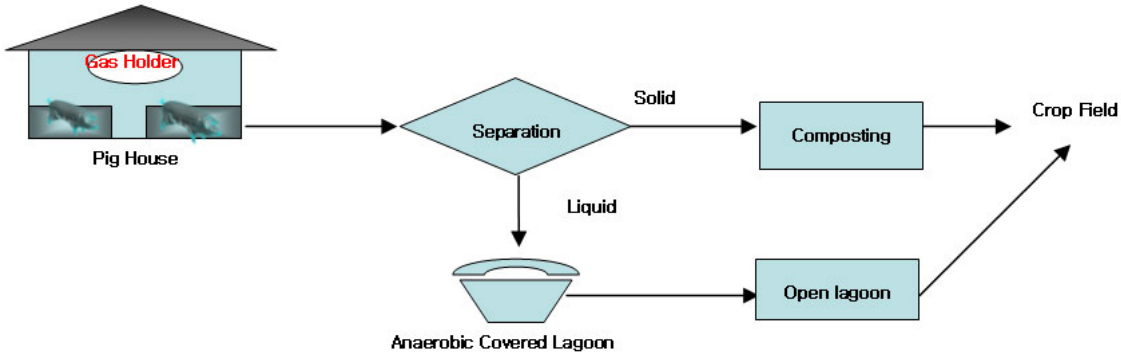

Figure 2.1 A proposed system for demo. farms in the 1st group in Tan an commnue

- **Financial Situation** In regard to the clause ⑦,the financial situation in **Table 2.2**, the consultant does not think it will matter whether the farms are qualified for the LWMEA project in Tan An Commune, because unlike China and Thailand, some pig farms in Vietnam do not have a proper treatment system and some do not have a proper size of the biogas digester. To make matters worse, the farms do not have enough cropland and fish pond. Thus improper management of pig slurry would not only severely damage the water quality of the stream in the region, but also the Dong Nai River and eventually the South China Sea.

Table 2.2 Numeric Significance Assessment of Criteria for Candidacy for 1st Group farm

Component	Assessment Clause	Observations & Analysis	Score
L	① if farm situates in blue	• The 1st group farm is bordered	**5**

	or green line	with Rach Dong River which is introduced into Dong nai river	
L	② if the candidate farm forms a cluster with other farms in operation	• the 1st group farms is a very typical example of a formation of a cluster	**5**
WQ	③ if farm wastewater is the major pollution source of waterstream	• It was not easy to examine the clause ③ due to lack of basic data. However, as shown in Figure 1.1, improper management of pig slurry may be a major source for water pollution because no other industries operate within this region other than agriculture.	**3**
WQ	④ if the farm currently pollutes a stream that is a primary or secondary tributary of the Dong Nai River	• As commented in clause ③, no detailed map is available, that depicts the tributaries in the region. However, because the 1st group farms border the stream, their impact on the stream can be easily identified.	**4**
WQ	⑤ if livestock operation tends to increase	• It depends on the pork price, which fluctuates up and down with time. However such business does not seem to be doing very well in China presently. It may not expand due to limited investment.	**3**
M	⑥ if the farm/farms is necessary to join the project from the standpoint of size and environmental impact.	• The average number of pigs in the 1st group is about 300 head. However the handling pattern of pig wastewater should be 'on the alert' status. The details are referred in Section (1) of the text.	**5**
M	⑦ if the candidate farm is financially healthy	• the 1st group farm did not seem to be financially healthy. The details are referred in Section (2) of the text.	**3**
W	⑧ if local authority and farmers shows strong willingness to participate	• The consultant got the impression that the government at every level seemed to encourage the producers to participate in the LWMEA Project.	**3**
W	⑨ if local authority and farmers are willing to invest a potential counterpart fund and environmental management capacity	• The consultant was not fully persuaded that pig producers were ready to share costs for installation of treatment. Only 1/3 of total costs will be charged towards the producers which is the smallest ratio compared to two other states.	**3**
T	⑩ the selected farms are representative of the	• Athough the PMU has not done any technical design for this group,	**5**

	various pig production technologies in Tan An Province	the process design of a proposed system can be applied for 1st group with those of Tu Doung village by Constech Co. and slight modifications	
	Total Score		**39**

2. 2nd Group Pig Farms

1) Characteristics of 2nd Group Farm

The 2nd group includes two medium scale pig farms, as shown in **Table 2.3**. The total number of finisher and sow are 1,000 and 80+α, respectively. The total amount of pig wastewater produces approximately 3～4 m^3/day assuming that water of 30L/day/head is used for showering, cleaning, and leakage of drinking water etc.

Table 2.3 Characteristics of 2nd group of pig farm in Tan An Commune, S. VietNam

No	Township	Name of farm	no. of finisher, head	No. of sow head	Fish pond area, ha	Crop/Fruit land area, ha
1	Tan An	N.T.Dung	500	N/A	0.3	**2.5**
2	〃	N.T.L.Thuy	500	80	0.2	**1.5**
Total			**1000**	**80+α**	**0.10**	**1.5**

2) Present Pig Treatment System

Generally each pig farm has the treatment system shown in **Figure 2.2**. The farms operate a Vietnamese conventional biodigester underground with volume of 30m^3, made out of mud yellow soil bricks. The residual wastewater from the biodigester is stored in an open tank and introduced into an open lagoon. The water in the lagoon is used for irrigation of cropland the farmer's own near their pig farm. The biogas holder is placed underneath the roof of the pig house which is an efficient way to utilize space and is similar to what the Germans do.

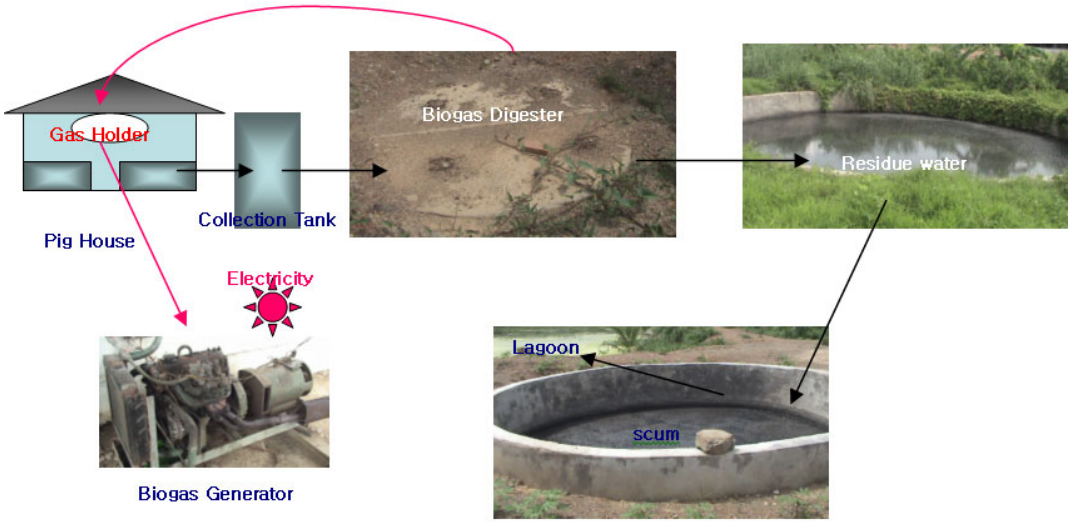

Figure 2.2 The present treatment system of pig slurry in the 2nd Group

3) Proposed Treatment System

Component	Assessment Clause	Observations & Analysis	Score
L	① if farm situates in blue or green line	• The 1st group farm is bordered with Rach Dong River which is introduced into Dong nai river	5
L	② if the candidate farm forms a cluster with other farms in operation	• the 1st group farms is a very typical example of a formation of a cluster	5
WQ	③ if farm wastewater is the major pollution source of waterstream	• It was not easy to examine the clause ③ due to lack of basic data. However, as shown in Figure 1.1, improper management of pig slurry may be a major source for water pollution because no other industries operate within this region other than agriculture.	4
WQ	④ if the farm currently pollutes a stream that is a primary or secondary tributary of the Dong Nai River	• As commented in clause ③, no detailed map is available, that depicts the tributaries in the region. However, because the 1st group farms border the stream, their impact on the stream can be easily identified.	4
WQ	⑤ if livestock operation tends to increase	• It depends on the pork price, which fluctuates up and down with time. However such business does not seem to be doing very well in China	3

		presently. It may not expand due to limited investment.	
M	⑥ if the farm/farms is necessary to join the project from the standpoint of size and environmental impact.	• The average number of pigs in the 1st group is about 300 head. However the handling pattern of pig wastewater should be 'on the alert' status. The details are referred in Section (1) of the text.	**5**
M	⑦ if the candidate farm is financially healthy	• the 1st group farm did not seem to be financially healthy. The details are referred in Section (2) of the text.	**3**
W	⑧ if local authority and farmers shows strong willingness to participate	• The consultant got the impression that the government at every level seemed to encourage the producers to participate in the LWMEA Project.	**3**
W	⑨ if local authority and farmers are willing to invest a potential counterpart fund and environmental management capacity	• The consultant was not fully persuaded that pig producers were ready to share costs for installation of treatment. Only 1/3 of total costs will be charged towards the producers which is the smallest ratio compared to two other states.	**3**
T	⑩ the selected farms are representative of the various pig production technologies in Tan An Province	• Athough the PMU has not done any technical design for this group, the process design of a proposed system can be applied for 1st group with those of Tu Doung village by Constech Co. and slight modifications	**5**
	Total Score		**40**

A new pig wastewater treatment system of the 2nd group consisting of two farms, was proposed by the PMU, VietNam, that is pretty much the same as the 1st group in **Figure 2.1**. Only difference is to add a new covered lagoon system in the overall system for 2nd group, shown in **Figure 2.3**. The PMU decided to use an existing underground, conventional VietNamese biodigester to reduce pollution strength with lower cost.

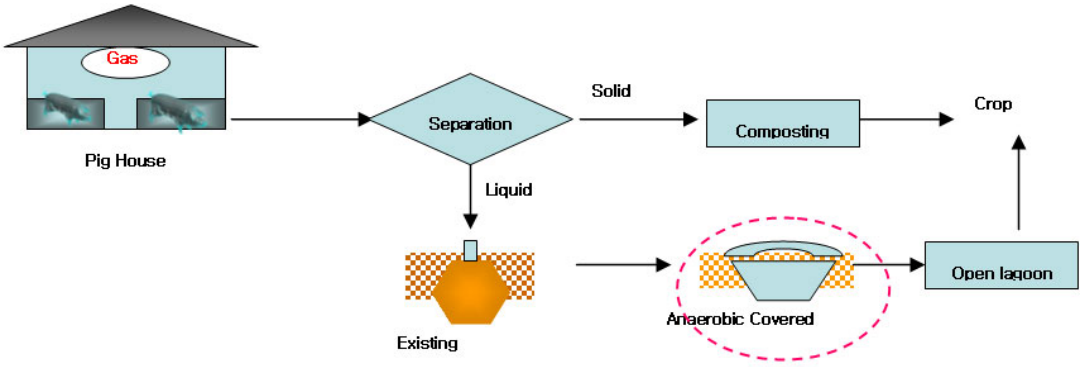

Figure 2.3 A proposed system for demo. farms in the 1st group in Tan an commnue

Table 2.4 Numeric Significance Assessment of Criteria for Candidacy for 2nd Group farm

3. 3rd Group

- **Characteristics of 3rd Farm** The characteristics of the 3rd group, a large scale pig farms, is given in **Table 2.5,** and its overall view is shown in **Figure 2.4.** Total number of finisher and sow are 3,000 and 300, respectively. Total amount of pig wastewater may produce 10 m^3/day including all sort of water used for production operation.

Table 2.5 Characteristics of 3rd group of pig farm in Tan An Commune, S. VietNam

No	Township	Name of farm	no. of finisher, head	No. of sow head	Fish pond area, ha	Crop/Fruit land area, ha
1	Tan An	N.H.Thang	3000	300	N/A	13

- **Present and Future Pig Treatment System** Basically this pig farm has been treating pig waste by spreading over cropland of 13 ha directly. However it emits offensive odor and salt build-up due to continous application.

- **A proposed system by PMU** is similar with that of other groups, shown in **Figure 2.5.** An anaerobic covered lagoon is designed for this farm size and their residue are transported into open lagoon, which can be utilized for cropping as liquid fertilizer and irrigation water.

Figure 2.4 Overall view of the 3rd group pig farm in Tan An Commnue

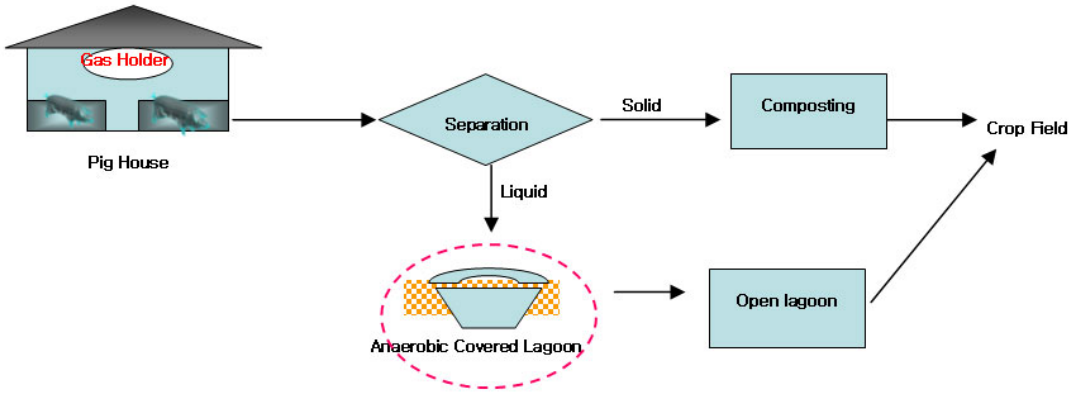

Figure 2.5 A proposed system for demo. farms in the 3rd group in Tan An commune

Table 2.6 Numeric Significance Assessment of Criteria for Candidacy for 2nd Group farm

Component	Assessment Clause	Observations & Analysis	Score
L	① if farm situates in blue or green line	• The 1st group farm is bordered with Rach Dong River which is introduced into Dong nai river	4
L	② if the candidate farm	• the 1st group farms is a very typical	4

	forms a cluster with other farms in operation	example of a formation of a cluster	
WQ	③ if farm wastewater is the major pollution source of waterstream	• It was not easy to examine the clause ③ due to lack of basic data. However, as shown in Figure 1.1, improper management of pig slurry may be a major source for water pollution because no other industries operate within this region other than agriculture.	**3**
WQ	④ if the farm currently pollutes a stream that is a primary or secondary tributary of the Dong Nai River	• As commented in clause ③, no detailed map is available, that depicts the tributaries in the region. However, because the 1st group farms border the stream, their impact on the stream can be easily identified.	**3**
WQ	⑤ if livestock operation tends to increase	• It depends on the pork price, which fluctuates up and down with time. However such business does not seem to be doing very well in China presently. It may not expand due to limited investment.	**5**
M	⑥ if the farm/farms is necessary to join the project from the standpoint of size and environmental impact.	• The average number of pigs in the 1st group is about 300 head. However the handling pattern of pig wastewater should be 'on the alert' status. The details are referred in Section (1) of the text.	**5**
M	⑦ if the candidate farm is financially healthy	• the 1st group farm did not seem to be financially healthy. The details are referred in Section (2) of the text.	**5**
W	⑧ if local authority and farmers shows strong willingness to participate	• The consultant got the impression that the government at every level seemed to encourage the producers to participate in the LWMEA Project.	**5**
W	⑨ if local authority and farmers are willing to invest a potential counterpart fund and environmental management capacity	• The consultant was not fully persuaded that pig producers were ready to share costs for installation of treatment. Only 1/3 of total costs will be charged towards the producers which is the smallest ratio compared to two other states.	**5**
T	⑩ the selected farms are representative of the various pig production technologies in Tan An Province	• Athough the PMU has not done any technical design for this group, the process design of a proposed system can be applied for 1st group with those of Tu Doung village by Constech Co. and slight modifications	**5**
	Total Score		**43**

D. Summary and Result of Assessment for Selection of 3 Groups Pig Farms

The consultant tabulated numeric score of three groups of six pig farms if the farms are eligible for participation of LWMEA Project. The nine clauses of selection criteria proposed by Guangdong PMO, was extended to 10 clauses to reflect local situations for VietNam, in general, The criteria were classified into the five categories including location, technology, water quality, management and finance, and willingness.

The followings are the consideration points for the locity of Vietnam unlikely with China and Thailand

1. Farm Size:

The pig farm size, clause ⑥, is originally designed to include in the selection criteria for the reason that a bigger farm may have a higher risk in appropriately treating pig slurry so that it should receive a higher priority for selection. However, the size of pig farms in Tan An commune ranges only 10s ~ 100s, that is not comparable to China, or Thailand. If you look over the production situation in Tan An commune, you are able to aware of the seriousness easily. Because smaller pig farms in general do not possess a proper pig wastewater treatment system and also sit densely in a limited space in the viilage so that the impact of improper treatment system may be more severe. than a larger and sparsely like Thai and China. Therefore the candidate groups of farms should allow to join the LWMEA Project.

2. Financial Situation:

In regard to the clause ⑦, financial situation in **Table 2.2**, the consultant does not think it is the matter of whether the farms are qualified LWMEA project in Tan An Commune, unlikely China and Thailand. Because either some pig farms in there do not have a proper treatment system or some do not have a proper size of the biogas digester due to investment constraints. To make matters worse, the farms do not possess enough cropland and fish pond. Thus improper management of pig slurry would impair seriously water quality of the stream in the region, and further Dong Nai River and eventually South China Sea.

3. Non Point Source:

Although **Annex 3 in Preparation Mission Aide-Menoire,** March 14-26, 2004 clearly mentioned if it influences main waterstream in corresponding region, the wastewater originated from livestock farms mixes with other sources like domestic wastewater. It is soon to become non-point source so it is not easy to identify the main source of the

pollution in any waterways. Thus the most feasible alternative seems to catch and treat the source at on-site.

4. Overall Score of the group :

The score of the 3 groups of six farms ranges from 39- 42, higher than 35 that the consultant sets the threshold score for selection. Each clause should fall in the class of 'moderate', 'good', or 'very good' that may provide the independent groups (pig farms, local and central government, FAO, and WB) with 'justification' for acceptance.

Table 3.1 Summary of Performance Score for the 3 Groups of six farms in Tan An commnue

No Group	Township	Owner name of farm	Total Score	Acceptance
1	Tan An	Lai, Dien, Thien	39	*Yes*
2	〃	Dung, Thuy	40	*Yes*
3	〃	**Thang**	**43**	*Yes*

5. Information and Data needed:

The information and data listed below are needed for efficient implementation of the Project by the PMU, Vietnam in near future :

1) Geological information about Tan An Commnue with tributaries and streams.
2) Farm arrangement of six farms with dimension and distance for layout
3) PIP for three groups of six pig farms for technical design for Tan An Commnue

6. Categorical Performace of the Groups :

The five categories, including location, technology, water quality, management and finance, and willingness, were featured to provide us with intuition for selection criteria of each groups of the corresponding farms.